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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/603,729	06/24/2003	Katsumi Yamamoto	8228.P015	3361

62294 7590 02/07/2008

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EXAMINER	
PETERSON, CHRISTOPHER K	

ART UNIT	PAPER NUMBER
2622	

MAIL DATE	DELIVERY MODE
02/07/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/603,729	YAMAMOTO, KATSUMI	
	Examiner	Art Unit	
	Christopher K. Peterson	2622	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 November 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-19* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-19* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. The Amendment After Non-Final Rejection filed on November 02, 2007 has been received and made of record.

Response to Arguments

2. Applicant's arguments filed November 02, 2007 have been fully considered but they are not persuasive.

First in regard to claims 1, 8 and 15, the Applicant argues that neither Tan (U.S. Pat. 6,043,481) nor the Assadi (U.S. Pat. 6,166,369) references teach "a raised ridge structure surrounding said micro-lens, wherein said raised ridge structure has a triangular cross-section and at least partially supports said micro-lens, wherein the micro-lens overlays a base portion of the raised ridge structure" as recited in the present claims. Applicant respectfully submits that a person of ordinary skill would predict the opposite. This is because on one hand Assadi discloses that it is desirable to form microlenses 24 before forming the reflective surfaces 12. Thus, there is no way for the reflective surfaces 12 to confine the microlenses 24 during reflow and no need to at least partially support the microlenses 24. Moreover, even if the microlenses 24 did overly a base portion of the reflective surfaces 12, the surface area available for the reflective surfaces 12 to reflect and focus light onto a photosensitive device through the microlenses 24 would be diminished. There would be no expectation of a successful,

improved product. Because there would be no expectation of success, there would be no predictability and thus claims 1, 8, and 15 are not rendered obvious over Tan in view of Assadi. Accordingly, claims 1, 8, and 15 are patentable over Tan in view of Assadi (See Remarks top of page 7). The Examiner respectfully disagrees. Specifically, noting the Tan reference teaches the purpose of the ridges is to separate the microlenses from each other (Col. 4, lines 1 - 8). The Applicant does agree that it appears that the purpose of the ridges in Tan is to separate the microlenses 18 from each other (See Remarks bottom of page 6). Tan (Fig. 4 and 9B) teaches contoured surface 10 has ridge elements 19; each ridge 19 is associated with one optoelectronic element 14. The ridge 19 operates to prevent contact of microlens elements 18 peripheries or other merging of the discrete lens elements in the array (Col. 4, lines 4 – 8). The ridge elements 19 of the contour surface (10) of Tan (Fig. 4) do not appear to have a triangular cross-section specified in the claim limitation. On the other hand the Assadi reference (Fig. 3) teaches and shows a ridge element that has a triangular cross-section (12 of Fig. 3). Assadi reference is used to show that the ridge elements 19 of Tan can be etched in a manner to where the cross section of the ridge is triangular in shape. For this reason, the Examiner believes that Tan in view of Assadi do teach the limitations of claims 1, 8 and 15, as will be set forth in further detail below.

Secondly in regard to claim 15, the Applicant argues that neither Tan (U.S. Pat. 6,043,481) nor the Assadi (U.S. Pat. 6,166,369) reference teach " any etching process, let alone "isotropically etching the top planarizing layer to form a raised structure over said top planarizing layer, said raised ridge structure encompassing said light sensitive

element; and forming a microlens within the interior of said raised ridge structure and over said light sensitive element, wherein said raised ridge structure has a triangular cross-section and at least partially supports said micro-lens, wherein the micro-lens overlays a base portion of the raised ridge structure." As such, this element of claim 15 is not disclosed in Assadi, as asserted by the Examiner. Nor is this element of claim 15 disclosed in Tan." Applicant asserts the Examiner interprets this disclosure to mean that an etchant, i.e., the diluted acid or base water solution, is used to chemically remove material from the substrate and states that "thus isotropic etching occurs to form the reflective surfaces 12 (See Remarks page 7 and 8). The Examiner respectfully disagrees. Isotropic etching is non-directional removal of material from a substrate via a chemical process using an etchant substance. The etchant may be a corrosive liquid or a chemically active ionized gas, known as plasma. Applying this definition of isotropic etching, Assadi teaches a process of producing the reflective surfaces (12) by using a spin coat to apply the proper film build requirement (create a layer of material on a substrate). The sol-gel glasses may be formed, for example, by hydrolysis of tetraethylorthosilicate (TEOS) and/or tetramethylorthosilicate (TMOS) with a photoinitiator that is added to the unsaturated glass hybrid polymer. The substrate is heated to cure the new material layer (Col. 3, lines 12 – 23). A quartz or glass mask 26 may be formed with a transmissive region to pass ultraviolet light indicated by the letter "U" in FIG. 4. The light exposes a region 30 in the underlying sol-gel layer 28. The layer 28 is positioned over the semiconductor structure 25. The quartz or glass mask 26 is a photo mask to block the areas of the reflective surfaces (12), which are not the

triangular ridge areas. In this example UV light photolithographic-type technique is used to create the triangular ridge areas by defocusing the light (creating the triangular shaped ridge area). After the triangular ridge areas are shaped isopropanol alcohol is used to remove the quartz or glass mask 26 layer and the unexposed parts of reflective surface (12) (Col. 3, lines 24 – 43). Examiner analyzes the isopropanol alcohol to be the etchant, because the isopropanol alcohol is used to remove the quartz or glass mask 26 layer and the unexposed parts of reflective surface (12). For this reason, the Examiner believes that Tan in view of Assadi do teach the limitations of claim 15, as will be set forth in further detail below.

Claim Rejections - 35 USC § 103

3. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 1-3, 6, 8-10, 13, and 15-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tan et al. (U.S. Pat. 6,043,481) in view of Assadi et al. (U.S. Pat. 6,166,369).

First, regarding **claim 1**, the Tan reference teaches an image sensor comprising a plurality~ of pixels formed in a semiconductor substrate (substrate 12), each pixel including a light sensitive element (optoelectronic elements 14), a micro-lens (micro-lens element 18) over each of the light sensitive elements, and a raised ridge structure (ridge elements 19) surrounding each of the micro-lenses, wherein the raised ridge

structure (19) at least partially supports the micro-lens (as shown in Fig. 9b), and further wherein the micro-lens (18) overlays a base portion of the raised ridge structure, as such an overlay is inherent in the reflow process of forming the micro-lens (18) between the ridge elements (19). Please refer to Figs. 4 and 9b, and Col. 3, Lines 35 - Col. 4, Lines 10. What the Tan reference fails to specifically teach is that the raised ridge structure has a triangular cross-section. However, the Assadi reference illustrates in Fig. 3 and discloses in Col. 2, Lines 5-8 and Lines 26-48 an image sensor comprising a raised ridge structure (reflective structure 12) having a triangular cross-section surrounding a micro-lens (micro-lens 24) over a photosensitive device (20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the raised ridge structure having a triangular cross-section, as taught by Assadi, with the image sensor of Tan. One would have been motivated to do so because as Assadi teaches in Col. 2, Lines 42-51, having a raised ridge structure with a reflective triangular cross-section allows more light to be reflected to the micro-lens for diffraction towards the photosensitive device, thereby improving the fill factor of the photosensitive device.

Next, considering **claim 2**, the Tan reference teaches the limitations above, and while Tan does teach that a raised ridge structure (19) is located around the periphery of each micro-lens (18), Tan does not specifically disclose that the raised ridge structure is circular. However, the Assadi reference does teach a raised ridge structure (reflective surfaces 12) that surrounds each micro-lens and circularly arranged around each photosensitive device (20) (See Col. 2, Lines 26-48 and Fig. 3).

As for **claim 3**, again the limitations of claim 1 are taught above, and the Tan reference illustrates in Figs. 4 and 9b that the raised ridge structure (19) confines the micro-lens (18).

Considering **claim 6**, the limitations of claim 1 are taught above, and Tan further discloses that the raised ridge structure (19) is formed from the same material (i.e. the raised ridge structure is part of light transmissive layer member 16) that underlies the micro-lenses (18). See Fig. 4 and Col. 3, Lines 37- 50.

In regard to **claim 8**, as is similarly disclosed above with respect to claim 1, the Tan reference teaches pixel of an image sensor comprising a light sensitive element (optoelectronic elements 14) formed in a semiconductor substrate (substrate 12), a micro-lens (micro-lens element 18) over the light sensitive element, and a raised ridge structure (ridge elements 19) surrounding the micro-lens, wherein the raised ridge structure at least partially supports the micro-lens, wherein the micro-lens (18) overlays a base portion of the raised ridge structure, as such an overlay is inherent in the reflow process of forming the micro-lens (18) between the ridge elements (19). Please refer to Figs. 4 and 9b, and Col. 3, Lines 35 - Col. 4, Lines 10. What the Tan reference fails to specifically teach is that the raised ridge structure has a triangular cross-section. However, the Assadi reference illustrates in Fig. 3 and discloses in Col. 2, Lines 5-8 and Lines 26-48 an image sensor comprising a raised ridge structure (reflective structure 12) having a triangular cross-section surrounding a micro-lens (micro-lens 24) over a photosensitive device (20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the raised ridge structure having a

triangular cross-section, as taught by Assadi, with the image sensor of Tan. One would have been motivated to do so because as Assadi teaches in Col. 2, Lines 42-51, having a raised ridge structure with a reflective triangular cross-section allows more light to be reflected to the micro-lens for diffraction towards the photosensitive device, thereby improving the fill factor of the photosensitive device.

In regard to **claim 9**, Tan in view of Assadi teaches the limitations of claim 8 above, and while Tan does teach that a raised ridge structure (19) is located around the periphery of each micro-lens (18), Tan does not specifically disclose that the raised ridge structure is circular. However, the Assadi reference does teach a raised ridge structure (reflective surfaces 12) that surrounds each micro-lens and circularly arranged around each photosensitive device (20) (See Col. 2, Lines 26-48 and Fig. 3).

Regarding **claim 10**, again the limitations of claim 8 are taught above, and the Tan reference illustrates in Figs. 4 and 9b that the raised ridge structure (19) confines the micro-lens (18).

As for **claim 13**, Tan in view of Assadi teaches the limitations of claim 8 above, and Tan further discloses that the raised ridge structure (19) is formed from the same material (i.e. the raised ridge structure is part of light transmissive layer member 16) that underlies the micro-lenses (18). See Fig. 4 and Col. 3, Lines 37-50.

Next, regarding **claim 15**, Fig. 9B and Col. 5, Lines 20-38 of the Tan reference teaches a method of forming a pixel of an image sensor comprising forming a light sensitive element (14) in a semiconductor substrate (12), forming a top planarizing layer (16) over the light sensitive element, forming a raised ridge structure (19) over the top

planarizing layer, the raised ridge structure encompassing the light sensitive element, and forming a micro-lens (18) within the interior of the raised ridge structure and over the light sensitive element, wherein the raised ridge structure at least partially supports the micro-lens, and further wherein the micro-lens (18) overlays a base portion of the raised ridge structure, as such an overlay is inherent in the reflow process of forming the micro-lens (18) between the ridge elements (19). What the Tan reference fails to specifically teach is that the raised ridge structure has a triangular cross-section, and that the top planarizing layer is isotropically etched to form the raised ridge structure. However, as illustrated in Fig. 3 and disclosed in Col. 2, Lines 5-8, Col. 2, Lines 26-48, and Col. 2, Line 54 - Col. 3, Line 43, the Assadi reference teaches an image sensor comprising a raised ridge structure (reflective structure 12) that is formed by isotropically etching the top planarizing layer (i.e. chemically removing portions of the top planarizing layer in both directions), wherein the raised ridge structure has a triangular cross-section surrounding a micro-lens (micro-lens 24) over a photosensitive device (20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the raised ridge structure having a triangular cross-section, as taught by Assadi, with the image sensor of Tan. One would have been motivated to do so because as Assadi teaches in Col. 2, Lines 42-51, having a raised ridge structure with a reflective triangular cross- section allows more light to be reflected to the micro-lens for diffraction towards the photosensitive device, thereby improving the fill factor of the photosensitive device.

In regard to **claim 16**, the limitations of claim 15 are taught above, and Tan further discloses that tile raised ridge structure (19) is formed in the top planarizing layer (16). Please refer to Figs. 4 and 9B, and Col. 3, Lines 41-45.

Next, considering **claim 17**, the limitations of claim 15 are set forth above, and the Tan reference illustrates in Figs. 4 and 9b that the raised ridge structure (19) confines the micro-lens (18).

As for **claim 18**, again the limitations of claim 15 are taught above, but Tan does not specifically teach that the raised ridge structure is a closed shape. However, as is illustrated in Fig. 2 and taught in Col. 2, Lines 30-34, the Assadi reference discloses that the raised ridge structure is a closed shape (e.g. a circle or orthogonal pattern).

Claims 4 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tan et al. (U.S. Pat. 6,043,481) in view of Assadi et al. (U.S. Pat. 6,166,369) further in view of Applicant's admitted prior art.

In regard to **claims 4 and 11**, the limitations of claims 1 and 8 are respectively taught above, but Tan in view of Assadi does not specifically disclose that the micro-lenses are formed from polymethylmethacrylate or polyglycidylmethacrylate. However, noting Para. [0025] of the Applicant's current specification, the Applicant discloses that the use of acrylics such as polymethylmethacrylate or polyglycidylmethacrylate is common in forming micro-lenses. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have formed the micro-lenses of Tan in view of Assadi using polymethylmethacrylate or polyglycidylmethacrylate. One

would have been motivated to do so because the use of common materials reduces manufacturing costs and the need for additional specialized manufacturing equipment.

Claims 5, 7, 12, 14, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tan et al. (U.S. Pat. 6,043,481) in view of Assadi et al. (U.S. Pat. 6,166,369) further in view of Nakai (U.S. Pat. 5,396,090).

Next, considering **claim 5**, the limitations of claim 1 are taught above by Tan in view of Assadi, but the combination fails to specifically disclose that the raised ridge structures have a height of about 0.2 microns. However, the Nakai reference teaches an image sensor having a plurality of micro-lenses (66) surrounded by a raised ridge structure (partition wall 51), wherein the partition wall 51 can have a height of 0.2 microns, as taught in Figs. 1 and 5, and Col. 4, Line 46 - Col. 5, Line 50. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have incorporated the raised ridge structure having a height of 0.2 microns, as taught by Nakai, with the raised ridge structure of Tan in view of Assadi. One would have been motivated to do so because by limiting the height of the raised ridge structure, the dimensions of the image sensor can remain small, therefore allowing for use in compact imaging devices.

As for **claim 7**, again the limitations of claim 1 are taught above, but Tan in view of Assadi does not disclose the use of a color filter layer between the micro-lenses and the light sensitive elements. However, the Nakai reference teaches the use of a color filter layer in the image sensor in Col. 6, Lines 28-31.

Regarding **claim 12**, the limitations of claim 8 are taught above, but Tan in view of Assadi fails to specifically disclose that the raised ridge structures have a height of about 0.2 microns. However, the Nakai reference teaches an image sensor having a plurality of micro-lenses (66) surrounded by a raised ridge structure (partition wall 51), wherein the partition wall 51 can have a height of 0.2 microns, as taught in Figs. 1 and 5, and Col. 4, Line 46 - Col. 5, Line 50.

In regard to **claim 14**, again the limitations of claim 8 are taught above, but Tan in view of Assadi does not disclose the use of a color filter layer between the micro-lenses and the light sensitive elements. However, the Nakai reference teaches the use of a color filter layer in the image sensor in Col. 6, Lines 28-31.

Finally, considering **claim 19**, Tan teaches the limitations of claim 15, but the method of Tan in view of Assadi fails to teach the use of a color filter layer between the micro-lenses and the light sensitive elements. However, the Nakai reference teaches the use of a color filter layer in the image sensor in Col. 6, Lines 28-31.

Conclusion

4. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the

shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christopher K. Peterson whose telephone number is 571-270-1704. The examiner can normally be reached on Monday - Friday 6:30 - 4:00 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, NgocYen Vu can be reached on 571-272-7320. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

CKP / TH
24 January 2008

NGOC-YEN VU
SUPERVISORY PATENT EXAMINER